EFFECTS OF TEBUTHIURON ON LESSER PRAIRIE CHICKEN HABITAT AND FOOD SUPPLIES

BY

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ABSTRACT

The effects of tebuthiuron treatments on lesser prairie chicken (Tympanuchus pallidicinctus) habitat and food supplies were examined from May 1978 to December 1979. Tebuthiuron treatments (0.2, 0.4, 0.6, 0.8, and 1.0 kg/ha) increased grass coverage 88 to 130% and density of bunchgrasses 12 to 23%, thereby improving nest and winter cover, but treatments decreased shinnery oak (Quercus havardii) density at least 84%, thereby eliminating thermal cover and important foods. Forb densities and seed production were maintained or increased in plots treated with 0.2, 0.4, and 0.6 kg/ha and were decreased in plots treated with 0.8 and 1.0 kg/ha. Generally, insect abundance was unchanged in treated plots compared to untreated plots. A rate of 0.4 kg/ha was recommended for shinnery oak management on private land in central west Texas because vertical cover was higher compared to cover in plots treated with higher tebuthiuron rates the 1st year. Also, forb and seed foods were not decreased as in plots treated with rates greater than 0.6 kg/ha. If areas are being managed solely for lesser prairie chickens then interspersion of areas treated with 2 rates of tebuthiuron (0.2 and 0.6 kg/ha) was suggested for producing optimum habitat. Sand dunes should not be treated to maintain summer thermal cover and shinnery oak acorn, gall, and catkin production for foods. Perennial grasses should be present before treatment with tebuthiuron to ensure a desired vegetation response and to reduce the threat of wind erosion.

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CHAPTER I

INTRODUCTION

The lesser prairie chicken is associated either with sand sagebrush (*Artemisia filifolia*) or shinnery oak communities throughout its range. In Texas, shinnery oak is an important lesser prairie chicken food and summer cover species (Jackson and DeArment 1963). However, the oak competes with other food and cover species and can comprise 90% of annual vegetation production in overgrazed habitat (Pettit 1979). Decreases in forage production and loss of livestock due to shinnery oak poisoning have prompted ranchers to control this plant with herbicides.

Control programs using phenoxy herbicides alter shinnery oak communities. Robison and Fisher (1968) and Scifres (1972) reported that grass production was 110 to 260% greater than pretreatment production following application of 2,4,5-T. However, grass production declined to pretreatment levels by the 3rd growing season as the shinnery oak resprouted. Bunch (1961), Bovey et al. (1972), and Deering (1972) also confirmed this trend.

The effects of phenoxy herbicides on lesser prairie chicken habitat and food supplies are poorly understood. Jackson and DeArment (1963) suggested that a continuing decline in lesser prairie chicken numbers after the 1956 drought was due partially to use of 2,4-D and 2,4,5-T for brush control. Copelin (1963) postulated that chemical brush control could reduce winter food.

He also mentioned that increased bunchgrass growth created by herbicide treatments might improve winter and nest cover. In Oklahoma, application of 2,4,5-T had no adverse effect on lesser prairie chicken populations inhabiting treated pastures (Donaldson 1969). Crawford (1974) observed that lesser prairie chicken numbers increased on areas treated once with 2,4,5-T and decreased on areas treated 2 consecutive years. Cannon (1980) found that lesser prairie chicken numbers were negatively correlated with shinnery oak canopy cover, suggesting control of this plant would improve habitat.

Urea-based tebuthiuron is another chemical used to control shinnery oak. Lade et al. (1974) found it was a stable, safe compound with an oral acute LD_{50} of 500 mg/kg in several animal species. Tebuthiuron is expected to suppress shinnery oak longer than phenoxy herbicides because it root-kills, whereas phenoxy herbicides top-kill shinnery oak. Pettit (1979) found that tebuthiuron rates exceeding 1.0 kg/ha controlled 90% of the shinnery oak. Grass yields increased 5-fold the 1st year after application. However, the effects of tebuthiuron on lesser prairie chicken habitat and food supplies have not been studied.

Occupied range of lesser prairie chickens has decreased 92% since the 1800's (Taylor and Guthery 1980b). Also, 95% of lesser prairie chicken habitat is privately owned. Since ranchers may be considering tebuthiuron as a tool for managing shinnery oak, it is important to determine the habitat changes created by this herbicide.

The objectives of this study were to determine the effects of tebuthiuron treatments on lesser prairie chicken habitat and food supplies.

CHAPTER II

STUDY AREA AND METHODS

The study was conducted 100 km southwest of Lubbock, Texas, on the south-central border of Cochran County (Fig. 1) during May 1978 through December 1979. The area is within a narrow belt of sandy soils originating in New Mexico. The soils are primarily Brownfield, Patricia, and Tivoli. Study plots were on relatively level but occasionally rolling land.

Shinnery oak is the most abundant shrub on the study area. Yucca (*Yucca sp.*), sand sagebrush, and southwest rabbit-brush (*Chrysothamnus pulchellus*) are other conspicuous woody plants. The prevalent grasses are little bluestem (*Schizachyrium scoparium*), sand bluestem (*Andropogon gerardii*), threeawns (*Aristida spp.*), sand dropseed (*Sporobolus cryptandrus*), and lovegrasses (*Eragrostis spp.*). Forbs present include western ragweed (*Ambrosia psilostachya*), annual buckwheat (*Eriogonum annuum*), stiffstem flax (*Linum rigidum*), and rushpea (*Caesalpinia jamesii*).

Tebuthiuron was randomly applied onto 5-ha plots at 5 rates (0.2, 0.4, 0.6, 0.8, 1.0 kg/ha), with three replicates per treatment (Fig. 2), in May 1978. Three control plots also were established. These 18 plots had 20-m buffer zones separating each plot (Fig. 2). Pelleted tebuthiuron, consisting of 20% active chemical, was applied with a cyclone seeder mounted on a tractor. Plots were not grazed by cattle during the study.

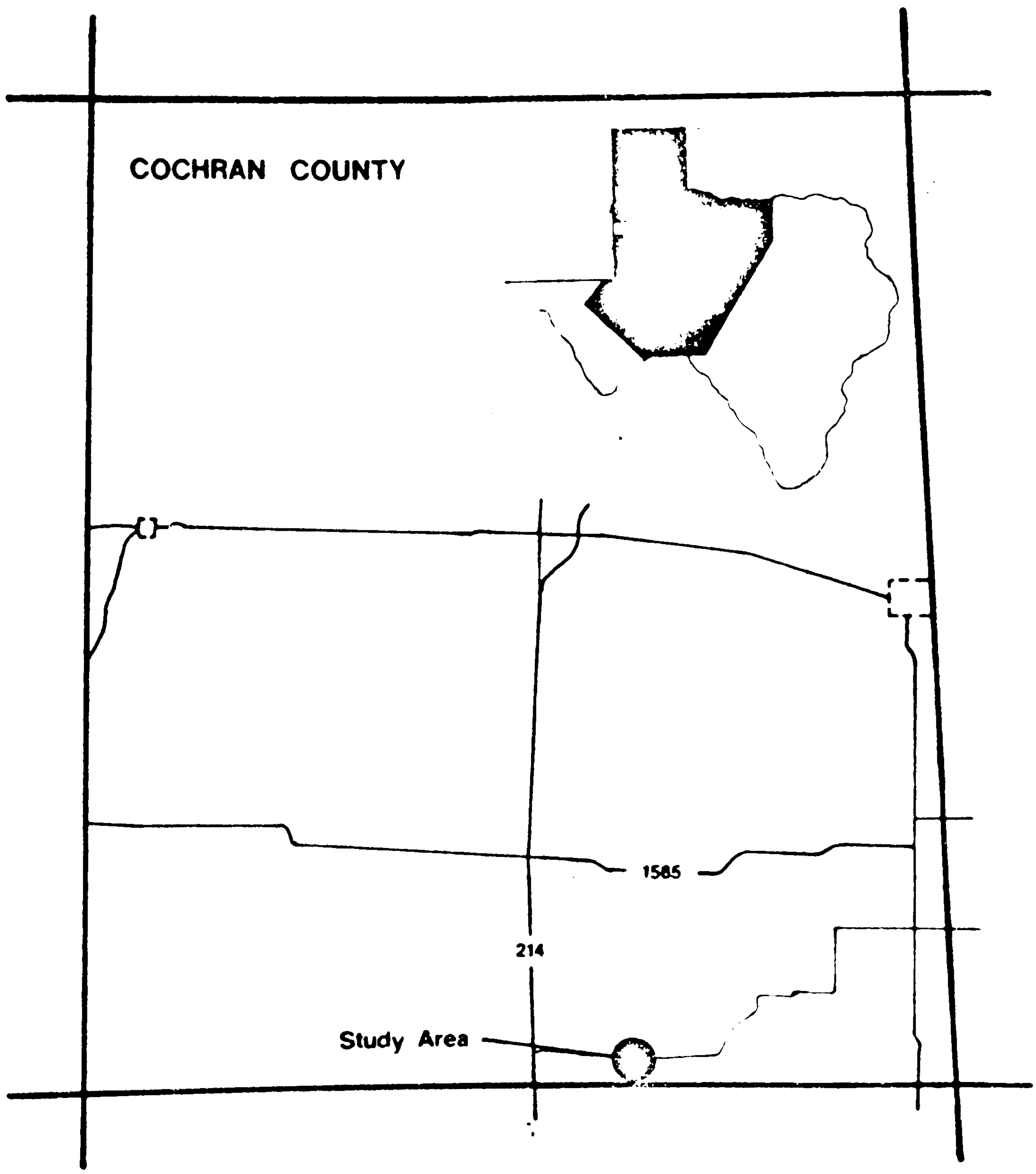

Figure 1. Location of study area in Cochran County, Texas during 1978 and 1979. Shaded area indicates original range of lesser prairie chickens in Texas.

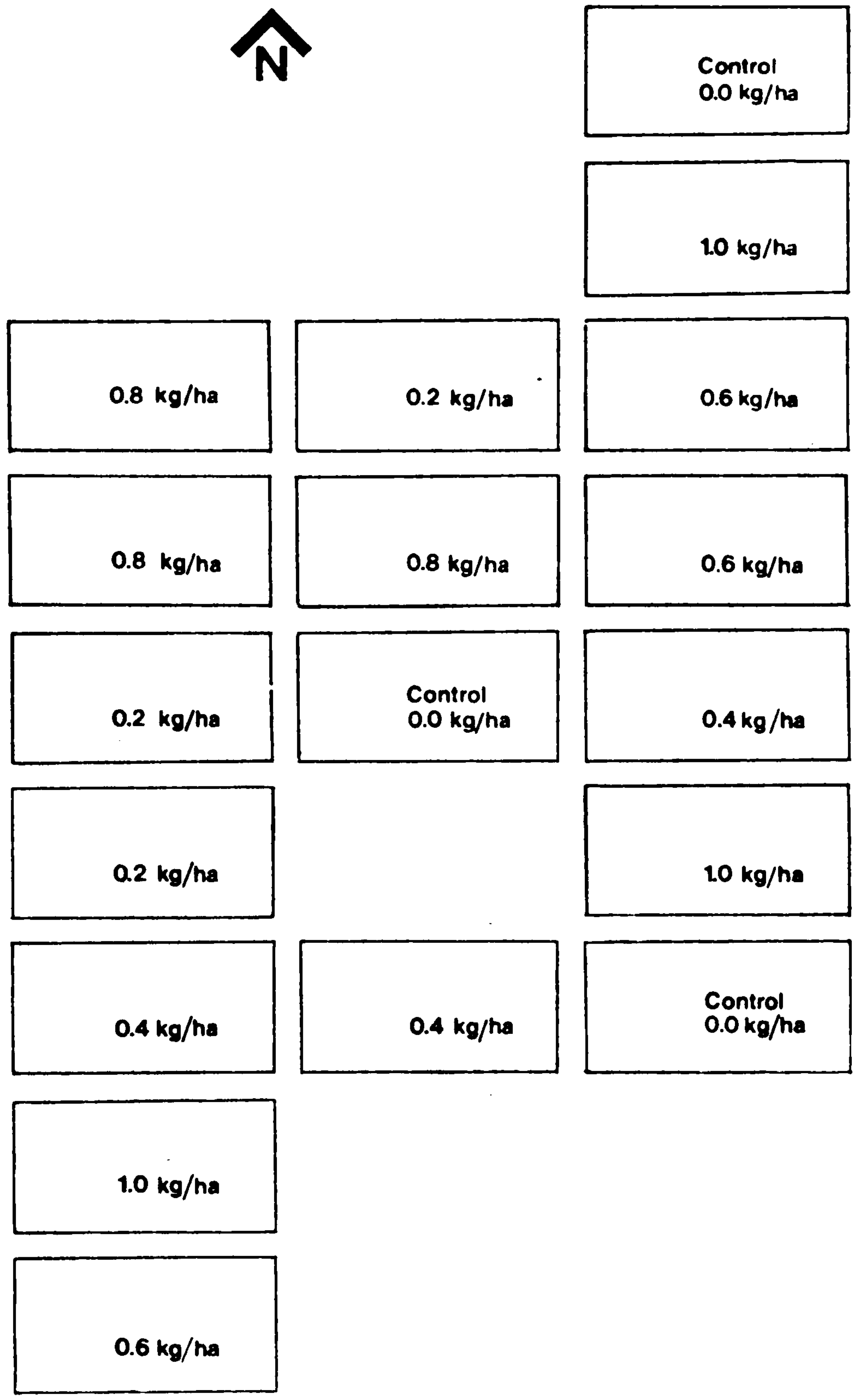

Figure 2. Plot arrangement and treatment rates of tebuthiuron in study area in Cochran County, Texas, during 1978 and 1979.

Vegetation Sampling

Vegetation composition and structure were measured in May, July, and September 1978 and 1979 to determine the effects of tebuthiuron treatments on lesser prairie chicken cover and plant foods. Quadrates (0.25 m^2) were placed at 40 permanent, randomly selected points in each plot. Density and canopy coverage (%) were recorded for each forb, grass, and brush species present. Density (no./m^2) and canopy coverage (%) for 1978 and 1979 were reported as an average of July and September readings combined. Forb densities were measured using 10 quadrates (0.25 m^2) per plot in December 1978, March 1979, and December 1979 to determine the effects of tebuthiuron treatments on cool-season forbs.

Vertical screening by foliage was measured to further define the effects of tebuthiuron on lesser prairie chicken cover. A profile board (Nudds 1977), as adapted by Guthery (pers. comm.), was used to estimate the percentage foliar obstruction within 1-dm strata on a board 1 m tall. Readings were taken from a distance of 7 m. The estimated percentage of a stratum that was abstracted by foliage was recorded in 1 of the following classes (0%, >0-5%, >5-20%, >21-40%, >41-60%, >61-80%, >81-95%, and >96-100%). Fifty profile board readings were taken in each treatment in October and November 1978 and May, September, and December 1979 to determine the structural density of vegetation during nest, summer, and winter periods.

Diet Analysis

The food habits of lesser prairie chickens near the study area were determined to obtain site-specific information on the impacts of tebuthiuron treatments on lesser prairie chicken food supplies. Diets were studied throughout 1979 primarily through fecal analysis. Ten dropping groups were collected monthly. A dropping group consisted of at least 1 dropping found in an area about 12 cm in diameter. One dropping was randomly selected from each group and mixed with alcohol in a petri dish to separate food fragments. Twenty-five observation points were randomly selected throughout the petri dish. Insect material on or closest to each point was identified to order (Froppe and Gilbert pers. comm.), providing data on percentage composition of each order. Samples were then oven-dried, mounted on microscope slides, and analysed using microhistological techniques (Hanson et al. 1971). Percentage relative frequency of each food item was determined by dividing the number of times a food item was found by the number of times all food items were found. Percentage relative frequency of each insect order was determined by multiplying the percentage composition of each order by the percentage relative frequency of all insects and dividing by 100.

Crops from 16 (March through May) and 8 (October) lesser prairie chickens were collected in 1979 to determine if bias was present in the fecal analysis (Swanson and Bartonek 1970). Foods were identified and measured volumetrically by water displacement (Martin et al. 1946). Percentage by volume was calculated by dividing the volume of a specific food item in a crop by the total volume of food found in that crop. Percentage frequency was calculated by dividing the frequency of a food item found in all crops by the total number of crops.

Seed Sampling

Seed production was sampled 2 ways to determine the effects of tebuthiuron treatments on these lesser prairie chicken foods. Seed collectors (Davison et al. 1955) were used during 1979. Four collectors were placed randomly in each plot in March 1979 and emptied in August and November 1979. Seeds were classified into 2 types: (1) forbs and (2) grass seeds potentially eaten by lesser prairie chickens, including sand paspalum (*Paspalum setaceum*), sand dropseed, and hairy grama (*Bouteloua hirsuta*). Each type was weighed to the nearest 0.0001 g. Seed production also was measured in each treatment during October 1979 by clipping 10 randomly selected plants (Hunt and Lutz 1959) of four species: sand dropseed, sand paspalum, stiffstem flax, and annual buckwheat, which have been found to be eaten by lesser prairie chickens (Jones 1963, Crawford 1974). Seeds were stripped from plants, dried for 48 hours at 40 C and weighed by species to the nearest 0.0001 g. Average weights for each species were multiplied by its density to get production (kg seed/ha).

Standing crop biomass of seeds was measured again in November 1979, after seed shattering, to further define the effects of tebuthiuron treatments on lesser prairie chicken foods. Ten soil samples (10 X 10 X 1 cm) were taken in each plot with a 10-cc subsample taken from each. Seeds were classified into 2 types: (1) forb and (2) grass seeds potentially eaten by lesser prairie chickens. Samples were dried for 24 hours at 40 C, weighed to the nearest 0.0001 g, and reported as g/10 cc.

Insect Sampling

Abundance and composition of insects in experimental plots were sampled to determine the effects of tebuthiuron treatments on these important lesser prairie chicken foods. Insects in upper vegetational strata were sampled bimonthly from June through October of 1978 and 1979 using a sweep net (Borror and Delong 1964). Sweep samples were run on 2, 200-m transects in each plot using 70, 1-m wide sweeps per transect. Ground-dwelling insects were measured bimonthly from June to December 1978 and April through December 1979 using pitfall traps (Borror and Delong 1964). Ten pitfall traps were placed at 10 permanent-random points in each plot and sampled for 3 consecutive days. Each trap consisted of a can (10-cm diameter) buried level with the soil surface and partially filled with glycerin (preservative). Invertebrates were identified to family using taxonomic keys (Borror and Delong 1964, Borror and White 1970), and the assistance of the Department of Entomology, Texas Tech University. Samples were oven-dried 24 to 48 hours at 40 C, counted, and weighed by family.

Statistical Analyses

Densities and canopy coverage of vegetation and insect data were transformed ($\sqrt{X+0.5}$) (Steele and Torrie 1960) because of a high frequency of zeros. Both raw and transformed data were analysed under a Completely Randomized Design. Duncan's New Multiple Range test was used to test for significant differences among means. The significance level throughout this paper is 5%. Diversity of insect families and forb species was measured using Simpson's (1949) index. The index varies directly with number of species found and equality of numbers among species.

Botanical nomenclature followed Gould (1975).

CHAPTER III

RESULTS AND DISCUSSION

Vegetation Response

Changes in the structure and composition of vegetation began in 1978 and became pronounced in 1979 (Table 1). During 1978, shinnery oak densities and canopy coverage decreased over 90% in tebuthiuron-treated plots compared to untreated plots. Shinnery oak sprouts densities were significantly lower in control plots compared to densities in treated plots. During 1979, shinnery oak densities were 84 to 100% lower in treated plots (Table 2). Densities of shinnery oak seedlings were 54 to 100% lower in tebuthiuron-treated plots compared to densities in untreated plots.

The loss of shinnery oak in treated plots apparently reduced summer thermal cover for lesser prairie chickens. Copelin (1963) felt that thermal cover was critical during years of drought and this was the reason why birds occurred only in regions with brush. Therefore, the loss of shinnery oak could reduce populations of lesser prairie chickens. In 1979, the 0.2 kg/ha rate of tebuthiuron reduced shinnery oak canopy coverage to 14% of canopy coverage in control plots (Table 2), indicating limited thermal cover was available for lesser prairie chickens.

Sand sagebrush in the study area was rapidly defoliated by tebuthiuron. Basal sprouts appeared during 1979, but canopy coverage was negligible in treated plots. Sand sagebrush is an important cover plant for lesser prairie chickens (Hoffman 1963).

Table 1. Mean density (no./m^2) and mean canopy coverage (%) of shinnery oak and bunchgrasses during July and September 1978. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Shinnery oak		Shinnery oak sprouts		Bunchgrasses	
rate (kg/ha)	Density	Coverage	Density	Coverage	Density	Coverage
0.0	7.6^{a}	16.6^{a}	0.8^{a}	--*	12.0^{a}	7.0^{b}
0.2	$< 0.1^{b}$	$< 0.1^{b}$	3.2^{a}	--	14.0^{a}	8.6^{a}
0.4	0.0^{b}	0.0^{b}	1.4^{b}	--	12.0^{a}	8.8^{b}
0.6	0.0^{b}	0.0^{b}	1.4^{a}	--	13.6^{a}	7.7^{a}
0.8	$< 0.1^{b}$	$< 0.1^{b}$	1.0^{b}	--	12.8^{a}	8.1^{a}
1.0	0.0^{b}	0.0^{b}	1.0^{b}	--	9.6^{b}	$4.9^{a,b}$

*Sprouts cover not separated from shinnery oak cover.

Table 2. Mean density (no./m^2) and mean canopy coverage (%) of shinnery oak and bunchgrasses during July and September 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Shinnery oak		Shinnery oak sprouts		Bunchgrasses	
rate (kg/ha)	Density	Coverage	Density	Coverage	Density	Coverage
0.0	26.2^{a}	7.5^{a}	14.0^{a}	4.3^{a}	11.2^{b}	9.8^{b}
0.2	3.9^{a}	2.2^{b}	$6.4^{a,b}$	1.5^{b}	14.6^{a}	18.5^{a}
0.4	$0.7^{a,b}$	0.3^{c}	1.7^{b}	0.4^{c}	14.4^{a}	20.6^{a}
0.6	0.2^{c}	0.2^{c}	$0.2^{c,d}$	$< 0.1^{c}$	$12.8^{a,b}$	22.6^{a}
0.8	0.0^{c}	0.0^{c}	0.1^{d}	$< 0.1^{c}$	13.2^{a}	21.5^{a}
1.0	$< 0.1^{c}$	$< 0.1^{c}$	0.0^{d}	0.0^{c}	$12.8^{a,b}$	22.2^{a}

Cannon (1980) found that lesser prairie chicken populations were highly correlated with sand sagebrush canopy coverage. Therefore, lesser prairie chicken populations might decline after tebuthiuron treatments if they depend heavily on sand sagebrush. However, if other cover such as bunchgrasses is available, then the loss of sand sagebrush might not affect populations.

Bunchgrasses were analysed as a group because they provide superior nesting and wintering cover for lesser prairie chickens compared to shinnery oak (Davis et al. 1979, Taylor and Guthery 1980b). Species included were little bluestem, sand bluestem, sand dropseed, sand paspalum, and red lovegrass (*E. secundiflora*). In September 1978, there was no significant increase in bunchgrass densities or canopy coverage between treatments (Table 1). By 1979, canopy coverage in tebuthiuron-treated plots was 88 to 130% higher than canopy coverage in untreated plots (Table 2). The increased canopy coverage of bunchgrasses in treated plots suggests that tebuthiuron treatments improved nesting and wintering cover for lesser prairie chickens.

Vertical Structure of Vegetation

Profile board readings for October 1978, 4 months after application, of tebuthiuron showed that differences were minor between treatments in the vertical, structural density of vegetation (Table 3). Untreated and 0.2 kg/ha tebuthiuron-treated plots provided significantly greater screening than plots treated with

Table 3. Mean visual obstruction (%) of profile board strata by foliage in treated plots for October 1978. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Height above soil surface (dm)							
rate (kg/ha)	<1	>1–2	>2–3	>3–4	>4–5	>5–6	>6–7	>7–8
0.0	77.8^{a}	$57.9^{a,b}$	29.4^{a}	16.7^{a}	5.3^{a}	0.5^{a}	0.2^{a}	0.0^{b}
0.2	78.3^{a}	63.4^{a}	30.2^{a}	15.7^{a}	5.0^{a}	$1.6^{a,b}$	0.6^{a}	0.3^{a}
0.4	75.7^{a}	$58.8^{a,b}$	$25.3^{a,b}$	$12.9^{a,b}$	5.2^{a}	2.3^{a}	0.8^{a}	$0.3^{a,b}$
0.6	75.8^{a}	$57.9^{a,b}$	$24.5^{a,b}$	$12.4^{a,b}$	3.7^{a}	$1.1^{a,b}$	0.0^{a}	$0.3^{a,b}$
0.8	78.2^{a}	$48.4^{b,c}$	19.6^{b}	7.4^{b}	3.1^{a}	$1.1^{a,b}$	0.6^{a}	$0.1^{a,b}$
1.0	67.8^{a}	43.8^{c}	16.0^{b}	$9.5^{a,b}$	2.1^{a}	$1.5^{a,b}$	0.6^{a}	$0.2^{a,b}$

0.8 and 1.0 kg/ha from 0 to 4 dm above the soil surface. From 5 to 8 dm above the soil surface there was significantly lower screening in the control plots compared to all treatments.

Measurements in November 1978 showed that screening from 0 to 4 dm above the soil surface in untreated plots and plots treated with 0.4 kg/ha was significantly greater compared to screening in plots treated with 0.6 kg/ha (Table 4). Screening from 5 to 8 dm above the soil surface was significantly lower in untreated plots than screening in treated plots. The 1978 profile board measurements indicated that rates of 0.2, 0.4, and 0.6 kg/ha maintained more screening cover for lesser prairie chickens compared to plots treated with 0.8 and 1.0 kg/ha rates.

May 1979 profile board measurements showed that vertical screening in untreated plots was significantly higher than screening in all treated plots from 0 to 5 dm above the soil surface (Table 5). Screening was significantly greater from 0 to 3 dm in plots treated with 0.2 kg/ha compared to plots treated with 1.0 kg/ha. Untreated and treated plots did not provide significantly different screening from 5 to 8 dm above the soil surface.

The lower screening values for the treated plots were caused by the loss of shinnery oak. Riley (1978) found that lesser prairie chicken hens selected areas with higher grass composition for nesting. Vegetation screening in treated plots was primarily bunchgrasses. The screening in untreated plots was primarily shinnery oak. Therefore the treated plots were providing superior nesting cover compared to the untreated plots.

Table 4. Mean visual obstruction (%) of profile board strata by foliage in treated plots for November 1978. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Height above soil surface (dm)							
rate (kg/ha)	<1	>1-2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8
0.0	51.1^{a}	28.9^{a}	9.0^{a}	$4.8^{a,b}$	1.6^{a}	0.5^{a}	0.2^{a}	0.0^{b}
0.2	$47.3^{a,b}$	$23.9^{a,b}$	$7.5^{a,b}$	$4.3^{a,b}$	1.5^{a}	1.2^{a}	6.2^{a}	$0.1^{a,b}$
0.4	51.4^{a}	28.3^{a}	10.1^{a}	6.0^{a}	2.1^{a}	1.1^{a}	0.3^{a}	$0.1^{a,b}$
0.6	$38.2^{a,b}$	16.2^{b}	3.6^{b}	2.0^{b}	1.3^{a}	0.6^{a}	0.3^{a}	$0.1^{a,b}$
0.8	$43.4^{a,b}$	$22.6^{a,b}$	$7.5^{a,b}$	$4.4^{a,b}$	2.0^{a}	1.0^{a}	0.3^{a}	0.2^{a}
1.0	$40.2^{a,b}$	16.9^{b}	4.3^{b}	2.5^{b}	1.1^{a}	0.3^{a}	0.2^{a}	$0.1^{a,b}$

Table 5. Mean visual obstruction (%) of profile board strata by foliage in treated plots for May 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Height above soil surface (dm)							
rate (kg/ha)	<1	>1-2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8
0.0	93.2^{a}	82.1^{a}	52.4^{a}	24.4^{a}	63.3^{a}	0.3^{a}	0.0^{a}	0.0^{a}
0.2	$86.9^{a,b}$	46.8^{a}	16.9^{b}	4.8^{b}	1.8^{b}	0.8^{a}	0.1^{a}	0.0^{a}
0.4	$76.3^{b,c}$	43.7^{b}	$11.8^{b,c}$	4.4^{b}	1.4^{b}	0.3^{a}	0.1^{a}	0.1^{a}
0.6	71.9^{c}	36.3^{b}	$8.8^{b,c}$	2.2^{b}	0.4^{b}	0.1^{a}	0.0^{a}	0.1^{a}
0.8	$76.4^{b,c}$	37.6^{b}	$8.4^{b,c}$	2.6^{b}	0.7^{b}	0.3^{a}	0.1^{a}	0.1^{a}
1.0	68.9^{c}	39.1^{b}	7.6^{c}	2.6^{b}	0.6^{b}	0.3^{a}	0.0^{a}	0.0^{a}

Vertical vegetation screening measurements for September 1979 showed that screening in plots treated with 0.2 and 0.4 kg/ha was lower than screening in all other treated plots and untreated plots (Table 6). Screening measurements in plots treated with 0.6, 0.8, and 1.0 kg/ha were higher compared to measurement in the same treatments for October 1978 (Table 3). This substantial increase was due to increased grass vigor within these plots.

Profile board readings for December 1979 showed that screening in treated plots was higher than screening in untreated plots (Table 7). Vertical screening increases from 160 to 1600% in treated plots as compared to screening in untreated plots (Table 7) Bunchgrasses, the preferred winter cover (Taylor 1978, Davis et al. 1979), were more dense in tebuthiuron-treated plots, suggesting that these rates improved wintering cover for lesser prairie chickens. Trends in the vertical structure of vegetation on plots treated at 3 rates are portrayed in Fig. 3.

Lesser Prairie Chicken Diet

Fecal analysis indicated that insects were a dominant food during fall and summer, comprising 65 and 58%, respectively, of total foods (Fig. 4). Grasshoppers and crickets (Orthoptera) comprised the largest portion of insects consumed (Tables 8 and 9). James cryptantha (Cryptantha jamesii) was the most common forb found in samples during fall and summer. Shinnery oak foliage was also common in fall diets.

Table 6. Mean visual obstruction (%) of profile board strata by foliage in treated plots for September 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Height above soil surface (dm)							
rate (kg/ha)	<1	>1–2	>2–3	>3–4	>4–5	>5–6	>6–7	>7–8
0.0	92.3^{a}	77.9^{a}	44.9^{a}	18.8^{a}	$6.4^{a,b}$	0.8^{c}	0.5^{d}	0.0^{c}
0.2	76.8^{c}	40.9^{c}	10.9^{c}	5.9^{c}	2.1^{b}	$1.9^{b,c}$	$0.6^{c,d}$	0.2^{c}
0.4	$79.4^{b,c}$	55.7^{b}	15.7^{c}	8.9^{b}	2.8^{b}	$2.5^{b,c}$	$1.3^{b,c}$	1.0^{b}
0.6	$83.5^{a,b,c}$	57.0^{b}	26.8^{b}	$17.1^{a,b}$	8.8^{a}	5.1^{a}	$2.2^{a,b}$	1.4^{b}
0.8	$88.0^{a,b}$	$65.7^{a,b}$	30.8^{b}	19.1^{a}	9.3^{a}	5.3^{a}	2.6^{a}	1.5^{b}
1.0	$82.9^{a,b,c}$	58.2^{b}	29.4^{b}	$16.1^{a,b}$	$6.4^{a,b}$	$4.1^{a,b}$	2.5^{a}	2.1^{a}

Table 7. Mean visual obstruction (%) of profile board strata by foliage in treated plots for December 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Height above soil surface (dm)							
rate (kg/ha)	<1	>1–2	>2–3	>3–4	>4–5	>5–6	>6–7	>7–8
0.0	42.7^{b}	27.0^{c}	5.4^{c}	4.1^{c}	2.1^{c}	1.4^{c}	0.3^{b}	0.2^{c}
0.2	69.9^{a}	45.1^{b}	21.0^{b}	15.8^{b}	$7.9^{b,c}$	$5.8^{b,c}$	$2.3^{a,b}$	$1.2^{b,c}$
0.4	81.2^{a}	64.2^{a}	$30.8^{a,b}$	$23.7^{a,b}$	$13.6^{a,b}$	$11.2^{a,b}$	4.9^{a}	$1.6^{a,b}$
0.6	80.1^{a}	61.4^{a}	$30.9^{a,b}$	$24.8^{a,b}$	$14.1^{a,b}$	$10.7^{a,b}$	4.0^{a}	$1.9^{a,b}$
0.8	79.2^{a}	$61.7^{a,b}$	$31.6^{a,b}$	26.0^{a}	$13.8^{a,b}$	$11.3^{a,b}$	5.5^{a}	2.9^{a}
1.0	80.9^{a}	59.9^{a}	36.6^{a}	28.6^{a}	17.9^{a}	13.6^{a}	4.7^{a}	$2.0^{a,b}$

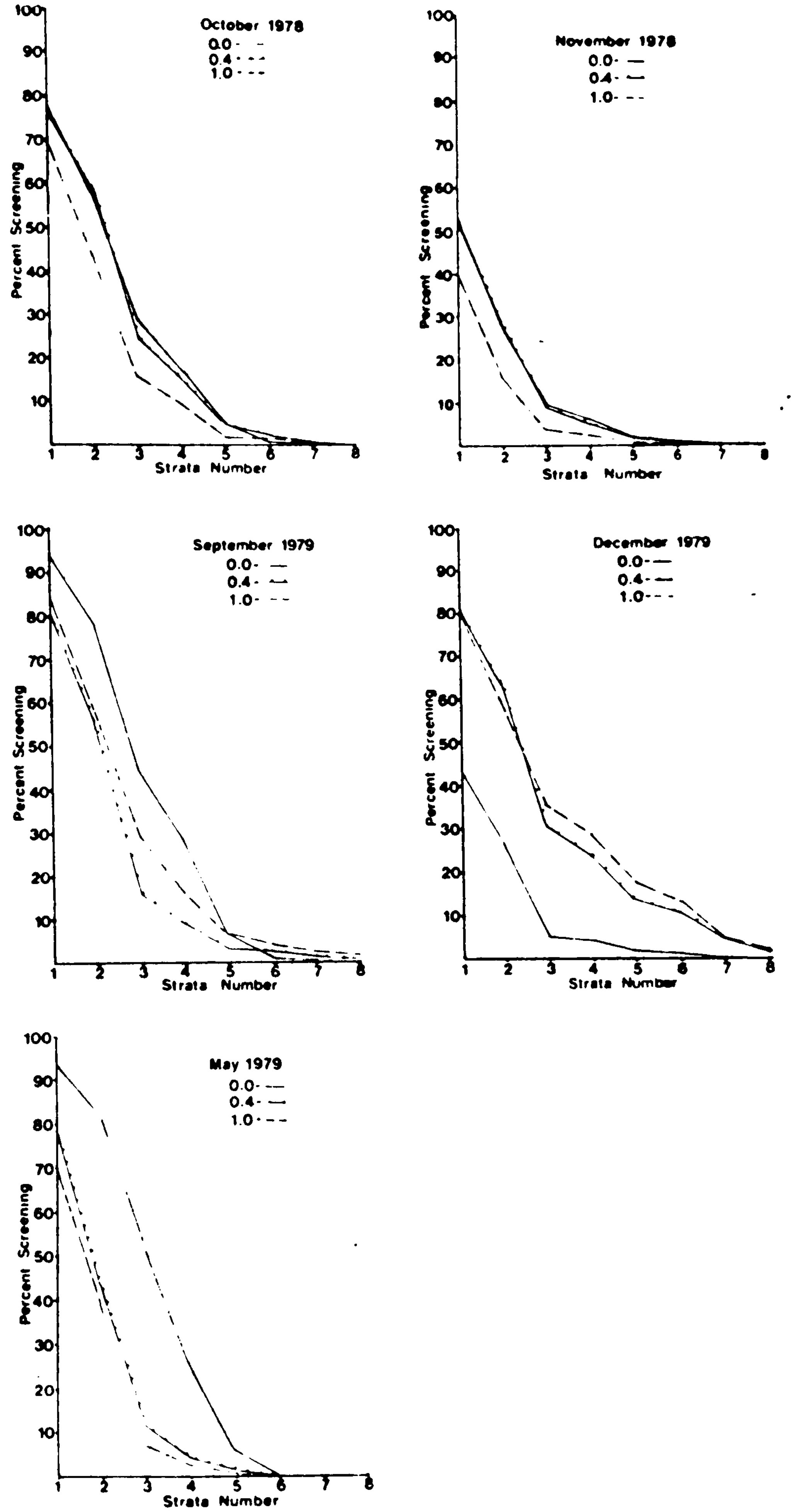

Figure 3. Mean percentage screening of profile board strata for 5 sample periods in untreated plots and plots treated with 0.4 and 1.0 kg/ha of tebuthiuron.

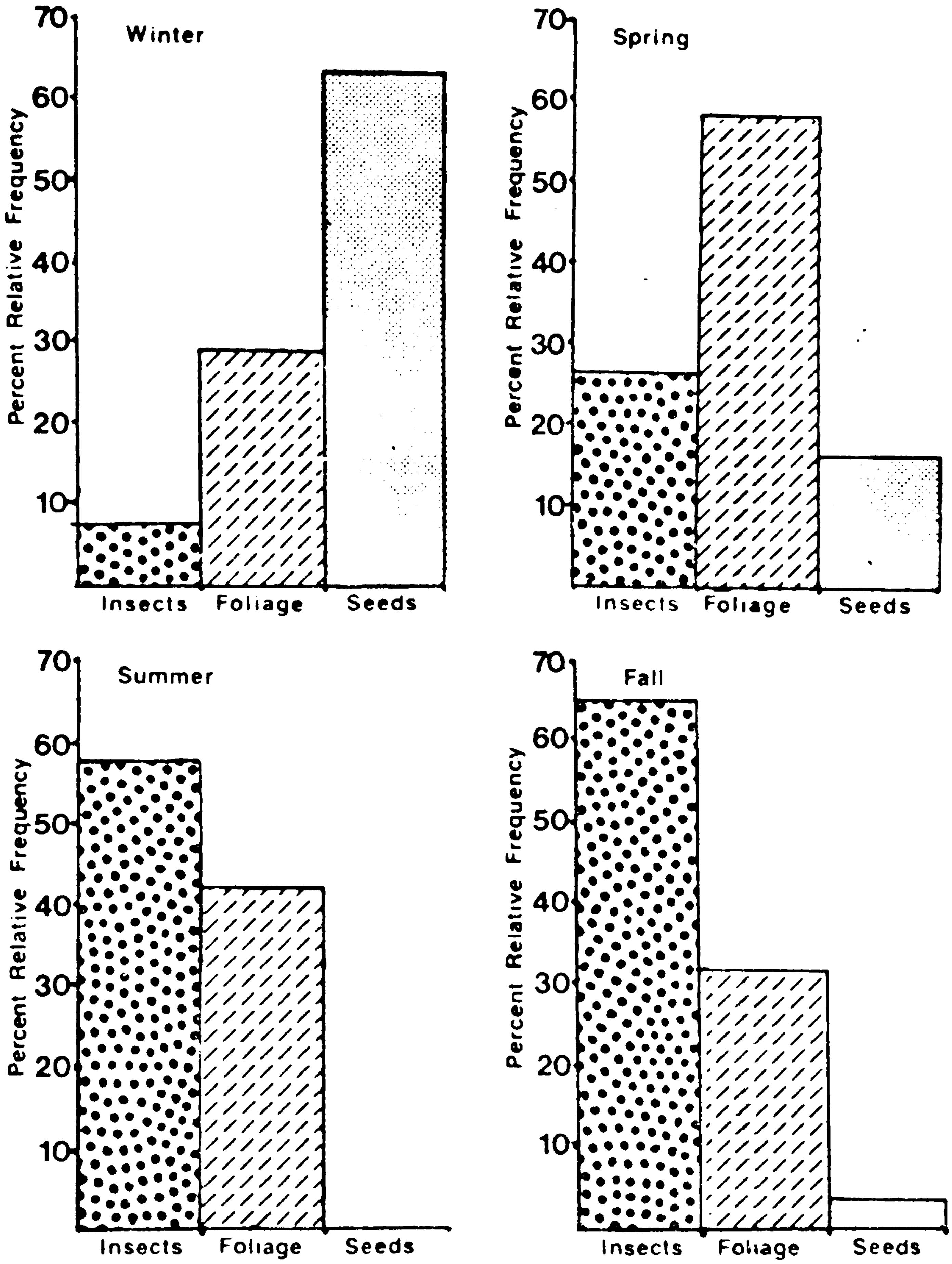

Figure 4. Percentage relative frequency of foods eaten by lesser prairie chickens during winter, spring, summer, and fall 1979 as determined by fecal analysis.

Table 8. Percentage relative frequency of foods found in 30 lesser prairie chicken fecal samples from June through August 1979.

Food Item	Relative Frequency (%)
Insects	
Grasshoppers and crickets (Orthoptera)	39.2
Beetles (Coleoptera)	16.0
Ants and wasps (Hymenoptera)	1.9
Treehoppers (Homoptera)	0.8
Unknown insects	1.7
Foliage	
James cryptantha (*Cryptantha jamesii*)	18.6
Erect dayflower (*Commelina erecta*)	7.8
James rushpea (*Caesalpinia jamesii*)	4.1
Stiffstem flax (*Linum rigidum*)	3.1
Shinnery oak (*Quercus havardii*) (catkins)	1.6
Gray goldaster (*Heterotheca subaxillaris*) Camphorweed (*H. canescens*)	1.2
Threadleaf sagewort (*Artemisia caudata*)	0.8
Sand sagebrush (*A. filifolia*)	0.6
Greenthread (*Thelesperma megapotamicum*)	0.6
Hairy evolvulus (*Evolvulus nuttallianus*)	0.4
Sedge (*Cyperus* spp.)	0.4
Unknown forb	0.4
White milkwort (*Polygala alba*)	0.2
Spectaclepod (*Dithyrea wislezeni*)	0.2

Table 9. Percentage relative frequency of foods found in 30 lesser prairie chicken fecal samples from September through November 1979.

Food Item	Relative Frequency (%)
Insects	
Grasshoppers and crickets (Orthoptera)	50.4
Beetles (Coleoptera)	8.6
Ants and wasps (Hymenoptera)	4.7
Treehoppers (Homoptera)	1.2
Foliage	
James cryptantha (*Cryptantha jamesii*)	18.2
Shinnery oak (*Quercus havardii*)	10.2
Unknown forb	1.0
Dotted gayfeather (*Liatris punctata*)	0.6
Florida snakecotton (*Froelichia floridana*)	0.3
Annual buckwheat (*Eriogonum annuum*)	0.3
Seeds	
Sand dropseed (*Sporobolus cryptandrus*)	1.6
Prickly pear (*Opuntia* spp.)	1.6
Sedge (*Cyperus* spp.)	0.6
Spectaclepod (*Dithyrea wislezeni*)	0.3
Stiffstem flax (*Linum rigidum*)	0.3

From December through February (winter), shinnery oak acorns were the dominant food and James cryptantha was the most common forb found in fecal samples (Table 10). Sand sagebrush was another important food.

Foliage was the major food found in fecal samples from March through May (spring) (Figure 4). James cryptantha and shinnery oak leaves were the major species found in fecal samples (Table 11). Grasshoppers and shinnery oak acorns were also important foods during the spring.

Relative volumetric proportions of foods in crops collected from March through May differed from percentage relative frequency in droppings during the same time period. Although insects were the most important food in crop and fecal analysis, these animals accounted for 68% of the volume in the crops (Table 12) and 27% of the relative frequency of foods in fecal samples (Table 11). Foliage accounted for 32% of the volume in the crops and 54% of the relative frequency of foods identified in droppings in spring.

Relative proportions of foods were similar in crop and fecal samples for fall. Insect material, particularly grasshoppers, composed a greater proportion of foods in crop samples (81%) (Table 13) than in fecal samples (50%) (Table 9). Fall crop analysis showed a high frequency of acorns and galls (62.5%), whereas fecal analysis showed no acorn material present but did show that shinnery oak foliage had a relative frequency of 10%.

The difference between fecal and crop analysis for the spring and fall is due partially to differential digestibility of

Table 10. Percentage relative frequency of foods found in 30 lesser prairie chicken fecal samples from December through February 1979.

Food Item	Relative Frequency (%)
Insects	
Grasshoppers and crickets (Orthoptera)	5.8
Ants and wasps (Hymenoptera)	1.0
Beetles (Coleoptera)	0.6
Treehoppers (Homoptera)	0.2
Foliage	
James cryptantha (*Cryptantha jamesii*)	17.8
Sand sagebrush (*Artemisia filifolia*)	7.3
Hairy evolvulus (*Evolvulus nuttallianus*)	2.3
Shinnery oak (*Quercus havardii*)	0.8
Spectaclepod (*Dithyrea wislezeni*)	0.4
Camphorweed (*Heterotheca subaxillaris*) Gray goldaster (*H. canescens*)	0.2
Narrowleaf gromwell (*Lithospermum incisum*)	0.2
Seeds	
Shinnery oak	60.5
Stiffstem flax (*Linum rigidum*)	1.2
Unknown forb	0.6
Prickly pear (*Opuntia* spp.)	0.4
James rushpea (*Caesalpinia jamesii*)	0.4
Sand dropseed (*Sporobolus cryptandrus*)	0.2

Table 11. Percentage relative frequency of foods found in 3) lesser prairie chicken fecal samples from March through May 1979.

Food Item	Relative Frequency (%)
Insects	
Grasshoppers and crickets (Orthoptera)	16.8
Beetles (Coleoptera)	4.9
Ants and wasps (Hymenoptera)	3.7
Treehoppers (Homoptera)	0.9
Unknown insects	0.4
Foliage	
James cryptantha (*Cryptantha jamesii*)	22.4
Shinnery oak (*Quercus havardii*)	19.0
Hairy evolvulus (*Evolvulus nuttallianus*)	5.1
Stiffstem flax (*Linum rigidum*)	2.0
Sand sagebrush (*Artemisia filifolia*)	1.2
Easter Daisy (*Townsendia exscapa*)	1.1
Gray goldaster (*Heterotheca subaxillaris*) Camphorweed (*H. canescens*)	1.0
Plains fleabane (*Erigeron modestus*)	0.9
Spiny haplopappus (*Machaeranthera pinnatifida*)	0.4
Narrowleaf gromwell (*Lithospermum incisum*)	0.3
Sedge (*Cyperus* spp.)	0.3
Greenthread (*Thelesperma megapotamicum*)	0.3
Erect Dayflower (*Commelina erecta*)	0.3
Buckley penstemon (*Penstemon buckleyi*)	0.1
Seeds	
Shinnery oak	15.9

Table 12. Quantitative and qualitative comparison of food items in the crops of 16 lesser prairie chickens collected March through May 1979.

Food Item	Volume (%)	Frequency (%)
Insects		
Grasshoppers (Acrididae)	32.2	43.8
Ants (Formicidae)	2.7	37.5
Treehoppers (Membracidae)	0.8	31.2
Unknown grasshoppers	9.0	18.8
Darkling beetles (Tenebrionidae)	18.8	18.8
Snout beetles (Curculionidae)	0.4	12.5
Ground beetles (Carabidae)	1.6	12.5
Spiders (Araneida)	0.6	12.5
Leef Beetles (Chrysomelidae)	0.4	6.3
Unknown beetles	0.4	6.3
Scarab beetles (Scarabaeidae)	0.6	6.3
Stinkbugs (Pentatomidae)	1.2	6.3
Unknown wasps	0.4	6.3

Table 12 cont. Quantitative and qualitative comparison of food items in the crops of 16 lesser prairie chickens collected March through May 1979.

Food Item	Volume (%)	Frequency (%)
Foliage		
Plains fleabane (Erigeron modestus)	7.8	25.0
Chinaberry (Melia azedarach)	4.3	18.8
Easter daisy (Townsendia exscapa)	5.5	18.8
Greenthread (Thelesperma megapotamicum)	5.9	18.8
Annual buckwheat (Eriogonum annuum)	5.9	12.5
James rushpea (Caesalpinia jamesii)	1.2	12.5
Shinnery oak (Quercus havardii)	0.2	4.3
Seeds		
Shinnery oak	1.6	12.5
Sand dropseed (Sporobolus cryptandrus)	5.1	6.3
Tumble lovegrass (Eragrostis sessilspica)	< 0.1	6.3

Table 13. Quantitative and qualitative comparison of food items in the crops of 8 lesser prairie chickens collected October 1979.

Food Item	Volume (%)	Frequency (%)
Insects		
Grasshoppers (Acrididae)	81.0	75.0
Stinkbugs (Pentatomidae)	4.1	75.0
Treehoppers (Membracidae)	0.2	37.5
Scarab beetles (Scarabaedae)	0.9	12.5
Ants (Formicidae)	0.1	12.5
Unknown larvae	0.1	12.5
Foliage		
Prickly pear (*Opuntia* spp.)	2.4	12.5
Spurge (*Euphorbia missurica*)	0.1	12.5
Seeds		
Shinnery oak (*Quercus havardii*)	2.8	62.5
Stiffstem flax (*Linum rigidum*)	8.1	25.0

foods. Insects and seeds are not completely digestible and pass through digestive tracts slowly (Swanson and Bartonek 1970). Forb leaves are readily digestible and pass rapidly through digestive tracts. Therefore the percentage relative frequency of insects and seeds reported in the fecal analysis may have been higher than what actually was eaten by lesser prairie chickens. Many forbs are detected in fecal analysis because characteristic epidermal hairs are not readily digestible (Scott and Dahl 1980). Some forbs have exceptionally dense epidermal hairs which result in these species being overestimated in fecal analysis. James cryptantha is 1 species where this may have occurred. This also would have lowered the percentage relative frequency of insects reported in the fecal analysis. Generally, lesser prairie chickens depended on insects (mainly grasshoppers and beetles), a diversity of forbs, shinnery oak acorns, and seeds from stiffstem flax and sand dropseed.

Seasonal diets of lesser prairie chickens in Cochran County were similar to those reported from Oklahoma (Jones 1964), New Mexico (Davis et al. 1979), and Texas (Crawford 1974). In Oklahoma, diets appeared more balanced throughout the year with no food exceeding 65% of the diet during a season (Jones 1964). Davis et al. (1979) found a higher percentage of seeds consumed through most seasons (except winter). However, there was high similarity in percentages and species of foods consumed when the results of Davis et al. (1979) and this study are compared. Similarly, results of Crawford (1974) showed a higher consumption of foliage by lesser prairie chickens in the fall and a lower percentage frequency and volume for insects compared to fecal samples from Cochran County (Table 9). The slight differences in diet reported by this and other studies are probably due to availability of foods and the differences in analysis methods and reporting of the data.

Forb Response

Total forb densities and canopy coverage were lowered by 0.4, 0.6, 0.8, and 1.0 kg/ha tebuthiuron treatments during July and September 1978 (Table 14). Canopy coverage of forbs was greater in plots treated with 0.2 kg/ha compared to untreated plots. During July and September 1979, forb densities were greatest in plots treated with 0.2 kg/ha (Table 14). Forb densities in plots treated with 0.4 kg/ha were similar to densities in control plots, while densities in plots treated with 0.6, 0.8, and 1.0 kg/ha were significantly lower. Forb canopy coverage was greatest in plots treated with 0.4 kg/ha. Plots treated with 0.2 and 0.6 kg/ha had higher canopy coverage than untreated plots, whereas treatments of 0.8 and 1.0 kg/ha had the lowest canopy coverage.

Forb diversity during 1978 and 1979 was 2 to 3 times higher in treated plots compared to untreated plots (Fig. 5).

Cool season forb densities were lower in March and December 1979 in plots treated with 0.4, 0.6, 0.8, and 1.0 kg/ha than

Table 14. Mean density (no./m^2) and mean canopy coverage (%) of all forbs in treated plots for July and September 1978 and 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	1978		1979	
rate (kg/ha)	Density	Coverage	Density	Coverage
0.0	$6.4^{a,b}$	1.66^{a}	8.8^{b}	$2.85^{b,c}$
0.2	6.4^{a}	1.76^{a}	10.0^{a}	$3.75^{a,b}$
0.4	$3.6^{c,d}$	1.06^{b}	7.5^{b}	4.76^{a}
0.6	$4.4^{b,c}$	$1.42^{a,b}$	5.1^{c}	$3.33^{a,b,c}$
0.8	2.8^{d}	0.46^{c}	4.5^{c}	2.06^{c}
1.0	0.9^{e}	0.20^{c}	2.2^{d}	2.09^{c}

in the control and 0.2 kg/ha plots (Table 15). Plots treated with 0.2 kg/ha maintained or had higher densities,canopy coverage, and diversity than untreated plots during December 1978 and March and December 1979.

Scifres and Mutz (1978) found many forb species were killed at high tebuthiuron rates (2.0 and 3.0 kg/ha). Rates of 0.8 and 1.0 kg/ha tended to reduce forbs also. The increase of warm season forbs in 1979 may indicate the herbicide was no longer as active. Also, elimination of shinnery oak probably reduced competition for soil water and nutrients, which in turn favored forbs.

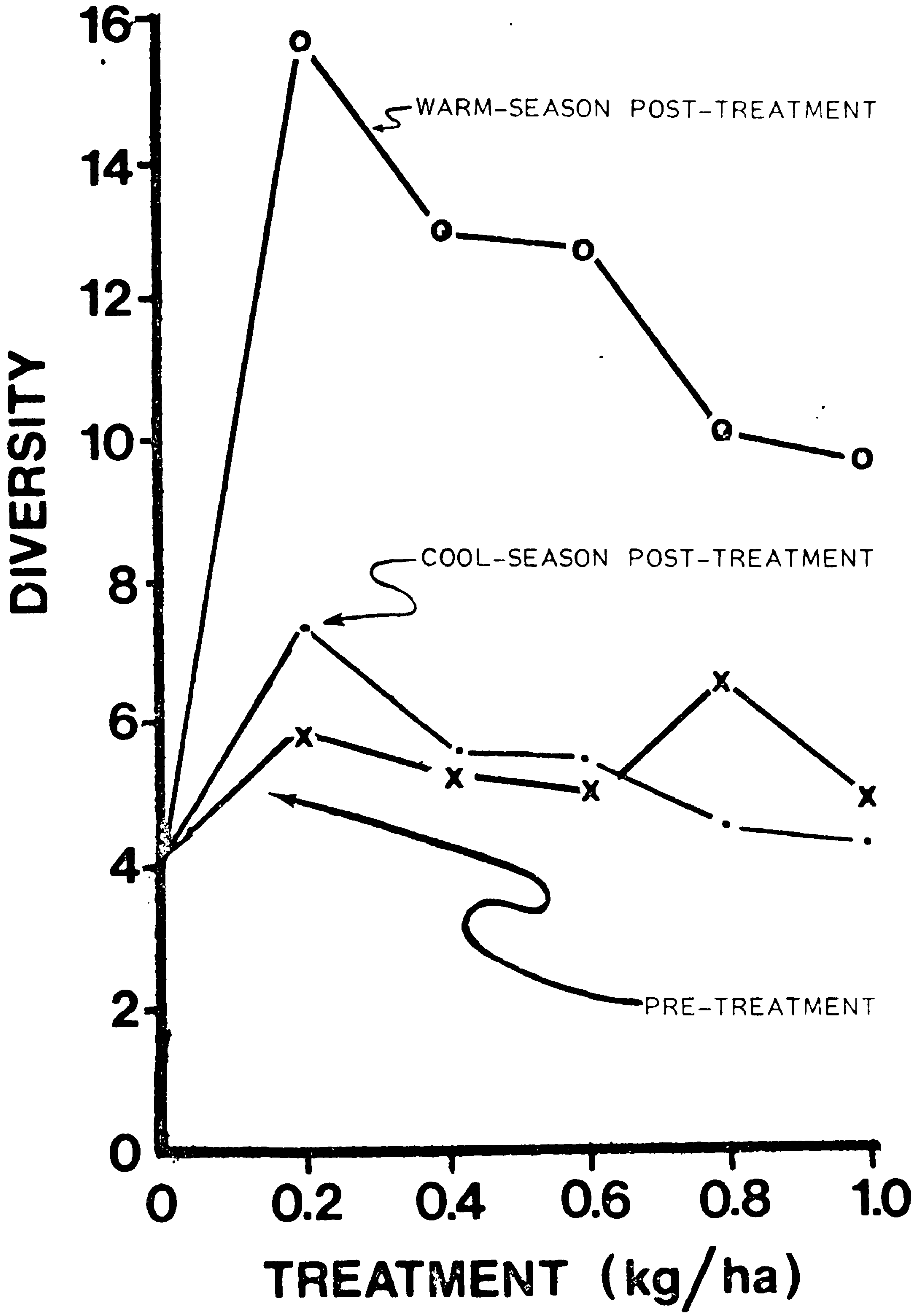

Figure 5. Diversity of forbs in plots in May 1978, mean diversity of warm-season forbs from July 1978 to September 1979 and mean diversity of cool-season forbs in December 1978 and 1979 and March 1979 in tebuthiuron-treated plots.

Table 15. Mean canopy coverage (%) and mean densities (no./m^2) of all forbs in treated plots for December 1978 and 1979 and March 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	December 1978		December 1979		March 1979	
rate (kg/ha)	Density	Coverage	Density	Coverage	Density	Coverage
0.0	5.5^{b}	$0.63^{a,b}$	8.4^{a}	$4.88^{a,b}$	22.05^{a}	$1.62^{a,b}$
0.2	12.5^{a}	1.14^{a}	6.8^{b}	6.83^{a}	25.4^{a}	1.82^{a}
0.4	6.4^{b}	$0.50^{a,b}$	$2.8^{b,c}$	$3.07^{b,c}$	$12.4^{b,c}$	$1.15^{a,b}$
0.6	4.3^{b}	$0.46^{a,b}$	4.4^{b}	$5.47^{a,b}$	7.6^{c}	$0.85^{b,c}$
0.8	4.8^{b}	$0.65^{a,b}$	1.2^{c}	1.53^{c}	7.6^{c}	0.43^{c}
1.0	2.8^{b}	0.20^{b}	$2.0^{b,c}$	$2.87^{b,c}$	10.0^{c}	0.55^{c}

Doerr and Guthery (1980) recommended a high diversity of forbs as a reasonable goal of habitat management for the lesser prairie chicken. Tebuthiuron treatments increased diversity, especially at 0.2 and 0.4 kg/ha rates (Figure 5). Also, 0.2 kg/ha rates had consistently higher densities and canopy coverage of forbs compared to all other plots. Therefore, these data indicate that 0.2 kg/ha treatments provided a more stable source of forbs for lesser prairie chicken foods than other treatments studied. Also, 0.4 kg/ha rates did not decrease forb populations and did increase diversity. Therefore this rate is probably not harmful to this lesser prairie chicken food supply. Jones (1963), Crawford (1974) and this study (Table 9) showed some consumption of sand sagebrush. Sand sagebrush, as mentioned earlier, was defoliated during 1978. The basal sprouts appearing in 1979 in all experimental plots may not provide cover but could be a limited food source.

Seed Production

Seed production in 1979, determined from seed collectors, indicated that tebuthiuron treatments did not significantly reduce forb or grass seed production (Table 16). Grass seed production for July 1979 was significantly higher in treated plots compared to untreated plots. Forb seed production was slightly lower in 0.8 and 1.0 kg/ha treatments for July 1979 compared to production in untreated plots.

Table 16. Seed production (kg/ha) of forbs and grass species known to be consumed by lesser prairie chickens as measured by seed collectors on tebuthiuron-treated plots for July[1] and November[2] 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron	Forbs		Grasses	
rate (kg/ha)	Jul.	Nov.	Jul.	Nov.
0.0	1.0[b]	0.3[a]	2.3[b]	4.3[a]
0.2	6.2[a]	0.4[a]	17.0[a]	0.6[a]
0.4	2.4[b]	0.1[a]	9.0[a,b]	1.9[a]
0.6	1.5[b]	0.9[a]	18.6[a]	14.7[a]
0.8	0.4[b]	0.1[a]	19.6[a]	0.5[a]
1.0	0.7[b]	4.3[a]	18.2[a]	14.7[a]

[1] July collectors measured production from March through July.

[2] November collectors measured production from August through November.

Seed production during 1979, calculated from individually clipped plants, showed some differences between treatments. Data for annual buckwheat showed that only 0.8 and 1.0 kg/ha significantly reduced seed production (Table 17). Data for stiff-stem flax indicated that rates of 0.2, 0.4, and 0.6 kg/ha significantly increased production compared to data from untreated plots. Sand paspalum seed production was increased in

Table 17. Mean seed weight (g/m^2) of selected species in treated plots during October 1979. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron rate (kg/ha)	Annual buckwheat	Stiffstem flax	Sand dropseed	Sand paspalum
0.0	$0.2^{a,b}$	0.04^{b}	3.2^{c}	0.6^{b}
0.2	0.5^{a}	$0.16^{a,b}$	14.4^{b}	1.0^{a}
0.4	$0.2^{a,b}$	0.28^{a}	19.2^{b}	0.5^{b}
0.6	0.1^{b}	0.12^{a}	$30.5^{a,b}$	1.0^{a}
0.8	$< 0.1^{c}$	0.04^{b}	96.5^{a}	1.0^{a}
1.0	$< 0.1^{c}$	0.01^{b}	2.6^{c}	0.6^{b}

plots treated with 0.2, 0.6, and 0.8 kg/ha compared to production in untreated plots. Seed production of sand dropseed increased significantly in all treatments except 1.0 kg/ha compared to production in untreated plots.

Seed standing crop biomass was not significantly different between treatments for forb and grass seed weights (Table 18).

Generally, plots treated with 0.2, 0.4, and 0.6 kg/ha produced more seed than the untreated plots and plots treated with 0.8 and 1.0 kg/ha produced less seed. Therefore, tebuthiuron treatments of 0.2 0.4, and 0.6 kg/ha may provide lesser prairie chicken populations a greater supply of seed foods. This increase

Table 18. Mean standing crop biomass of seeds (g/10 cc) of forbs and grasses known to be consumed by lesser prairie chickens from soil samples in tebuthiuron-treated plots. Means with different letters within columns are significantly different ($p < 0.05$)

Tebuthiuron rate (kg/ha)	Forbs	Grasses
0.0	0.0016[a]	0.0005[a]
0.2	0.0022[a]	0.0035[a]
0.4	0.0187[a]	0.0053[a]
0.6	0.0060[a]	0.0036[a]
0.8	0.0005[a]	0.0941[a]
1.0	0.0010[a]	0.0094[a]

is important because of the concurrent loss of shinnery oak (Tables 1 and 2), an important food source (Tables 8, 9, 10, and 13). Crawford (1974) reported that shinnery oak comprised 15% of the volume of fall foods in west Texas. Davis et al. (1979) reported that acorns provided 39 and 69% of the fall and winter diets, respectively, of lesser prairie chickens in New Mexico. They also noted that shinnery oak leaf galls and catkins were important foods during the year. However, lesser prairie chicken populations thrive in areas with no shinnery oak (Hoffman 1963, Jones 1963). Therefore, the loss of shinnery oak acorns, catkins, and galls may not be detrimental to populations if other foods increase sufficiently to replace them. The increased seed production and forb production and diversity in plots treated with 0.2 and 0.4 kg/ha indicate that these lesser prairie chicken foods may have increased sufficiently to replace shinnery oak food production. However, this cannot be determined conclusively without measuring the population response of lesser prairie chicken to tebuthiuron treatments.

Insect Response

Insect orders analyzed in detail included total insects, grasshoppers, beetles, wasps and ants (Hymenoptera), and bugs (Homoptera). Sweep net samples showed no significant difference between treatments for the orders analyzed (Table 19).

Pitfall samples suggested the treatments affected total insects and grasshoppers. Plots treated with 0.2 kg/ha had more total insects than most other treated and untreated plots (Table 20). Grasshoppers were more numerous in plots treated with 0.2 kg/ha than in plots treated with 0.4 and 1.0 kg/ha (Table 20). No significant differences were found in the biomass of orders during the study (Table 21). Insect diversity in the treated plots differed little from diversity in the untreated plots (Fig. 6). These data suggest that insect abundances and diversities were only slightly affected in plots treated with tebuthiuron. However, high variances were associated with the means in all analyses, indicating that sampling was inadequate to detect

Table 19. Mean biomass (g) of orders and total insects from sweep samples during 1978 and 1979 in tebuthiuron-treated plots.

Tebuthiuron rate (kg/ha)	Beetles (Coleoptera)	Treehoppers (Homoptera)	Ants and Wasps (Hymenoptera)	Grasshoppers (Orthoptera)	Total insects
0.0	0.0005	0.0037	0.0008	0.0804	2.1560
0.2	0.0007	0.0031	0.0015	0.1533	3.7342
0.4	0.0005	0.0034	0.0013	0.1299	3.2214
0.6	0.0001	0.0018	0.0021	0.1330	3.4536
0.8	0.0041	0.0022	0.0021	0.0998	2.8181
1.0	0.0004	0.0010	0.0014	0.1506	3.6660

Table 20. Mean number of total insects and orders analysed from pitfall samples. Means with different letters within columns are significantly different ($p<0.05$).

Tebuthiuron rate (kg/ha	Total Insects	Grasshoppers
0.0	$8.4^{b,c}$	$0.5^{a,b}$
0.2	9.3^{a}	0.7^{a}
0.4	$8.6^{a,b,c}$	0.3^{b}
0.6	$8.4^{b,c}$	$0.5^{a,b}$
0.8	$9.2^{a,b}$	$0.6^{a,b}$
1.0	8.3^{c}	0.3^{b}

significant differences in insect response to the tebuthiuron treatments.

Insects are a dominant food item of lesser prairie chickens, particularly in the summer and fall (Jones 1963, Davis et al. 1979). They composed more than 55% of the diet of lesser prairie chickens during fall and summer 1979 in this study (Table 8 and 11). Therefore, tebuthiuron treatments apparently may not affect the abundance of insects available for lesser prairie chicken foods.

Table 21. Mean biomass (g) and total insects of orders from pitfall samples during 1978 and 1979 in tebuthiuron-treated plots.

Tebuthiuron rate (kg/ha)	Beetles (Coleoptera)	Treehoppers (Homoptera)	Ants & Wasps (Hymenoptera)	Grasshoppers (Orthoptera)	Total insects
0.0	0.3082	0.0011	0.0266	0.2300	6.3504
0.2	0.4560	0.0024	0.0332	0.3917	6.5636
0.4	0.3210	0.0005	0.0623	0.3509	6.4009
0.6	0.2373	0.0013	0.0352	0.3805	6.3504
0.8	0.3797	0.0013	0.0661	0.3428	6.4516
1.0	0.3516	0.0007	0.0329	0.1959	6.3504

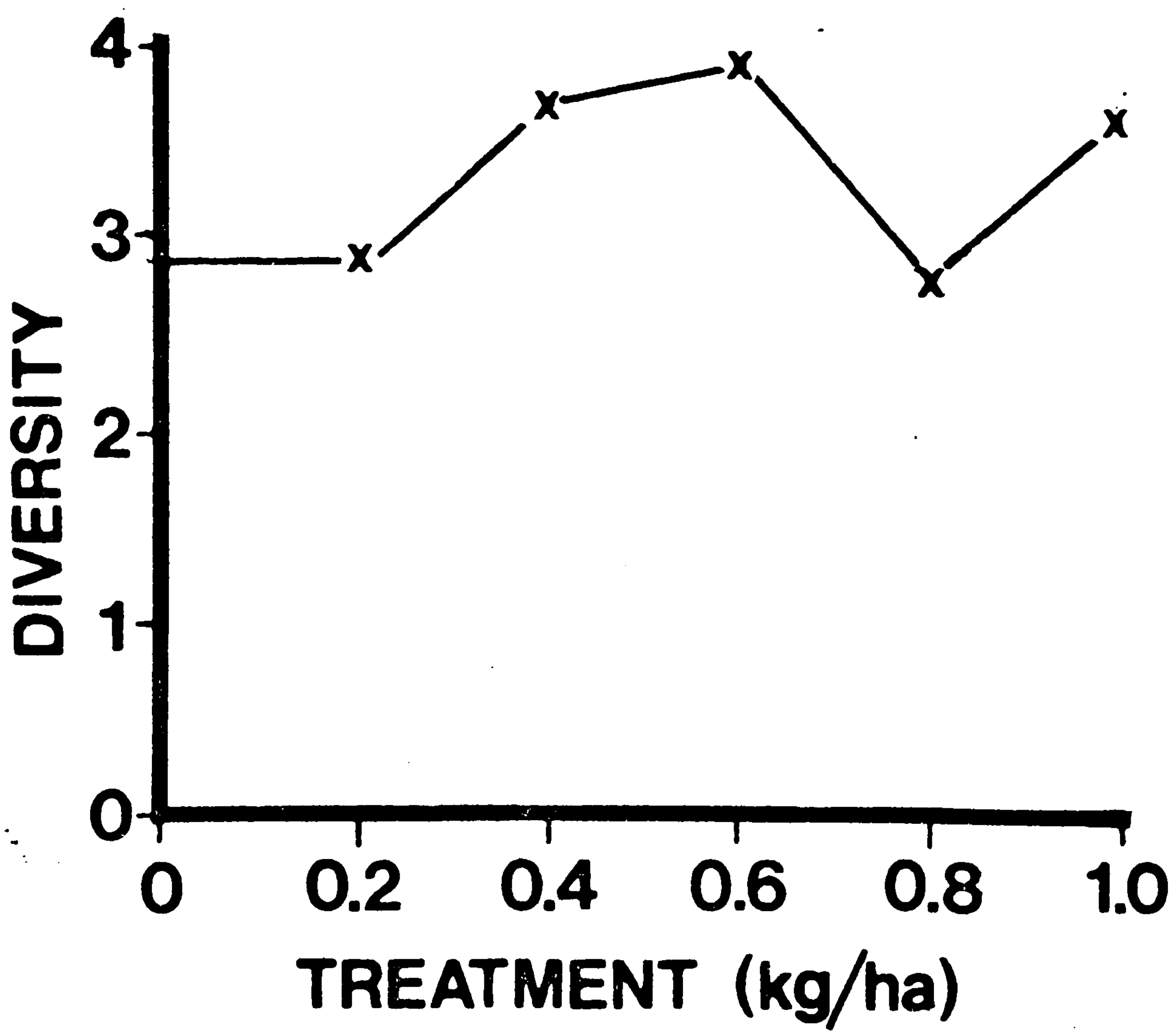

Figure 6. Mean diversity of insects from 1978 to 1979 in plots treated with different rates of tebuthiuron.

Summary

Tebuthiuron increased grass canopy coverage and therefore improved nest and winter cover for lesser prairie chickens. Low rates of tebuthiuron maintained or improved seed production, forb densities, canopy coverage, and diversity, and insect abundances thereby generally improving the diversity and stability of these lesser prairie chicken food supplies. High rates of tebuthiuron reduced densities, canopy coverage, and seed production of forbs. Insect abundances were maintained and grass seed production increased. All tebuthiuron rates reduced shinnery oak and sand sagebrush densities and canopy coverage. Sand sagebrush resprouted in 1979 to provide a limited food source for lesser prairie chickens while some shinnery oak was present in 1979 in plots treated with 0-2 kg/ha.

CHAPTER IV

MANAGEMENT IMPLICATIONS

Treatment of shinnery oak rangeland with tebuthiuron can maintain or improve lesser prairie chicken habitat and food supplies. Important exceptions were cover and foods supplied by sand sagebrush and shinnery oak. However, the loss of food was at least partially offset by increases in forbs and production of seeds by sand dropseed, annual buckwheat, stiffstem flax, and sand paspalum (Table 17).

Tebuthiuron applied at 0.4 kg/ha appears to be the best rate on sand soils for lesser prairie chicken habitat management. Vertical cover of vegetation was maintained the 1st year after application, whereas the cover provided by vegetation in plots with higher treatment rates was reduced in comparison to cover in untreated plots (Tables 3 and 4). Also, vertical coverage in plots treated with 0.4 kg/ha during 1979 was significantly higher than vertical coverage in plots treated with 0.2 kg/ha (Table 7). Unlike higher tebuthiuron rates, 0.4 kg/ha treatments maintained or increased seed production and density, canopy coverage, and diversity of forbs.

If areas are being managed solely for lesser prairie chickens, then interspersed treatments at rates of 0.2 and 0.6 kg/ha may provide optimal habitat for lesser prairie chickens. The 0.6 kg/ha rate provided high grass cover 2 years after application, provided livestock are excluded or managed to promote the grass response (Tables 6 and 7). Forb diversity (Fig. 4), density, and canopy coverage were equivalent to plots treated with 0.4 kg/ha (Table 14 and 15). The 0.2 kg/ha rate increased seed production and density, canopy coverage, and diversity of forbs. Also insects important to lesser prairie chickens appeared unaffected. Grass cover increased the 1st year; however, 2nd-year cover was lower compared to cover in higher tebuthiuron rates. Also, some shinnery oak survived at the 0.2 kg/ha rate and therefore provided limited cover and food production.

Whether a single rate (0.4 kg/ha) or 2 rates (0.2 and 0.6 kg/ha) are being applied, it is important that perennial bunchgrasses be present in the understory before herbicide treatments (McIlvain and Armstrong 1958, Gould and Hebel 1970, Doerr and Guthery 1980). If perennial bunchgrasses are absent, shinnery oak control produces communities of false buffalograss (Munroa squarrosa) and threeawns (Pettit pers. comm.). These species are of little value to lesser prairie chickens or livestock.

Sand dunes should not be treated with tebuthiuron, a urea-based herbicide, for several reasons. Dune areas have few perennial bunchgrasses on them. Therefore, if areas were treated, wind erosion would increase (McIlvain and Armstrong 1958). Shinnery oak foliage supplements the diet of cattle during drought years. Moreover, these dune areas will supply lesser prairie chickens with summer thermal cover and acorns, catkins, leaf galls, and foliage for food.

Tebuthiuron treatments should be applied on large blocks (150 to 300 ha) of land in rotation (Doerr and Guthery 1980). A total rotation should take 5 years to complete over 4 or 5 blocks. Herbicide applied to 1 block each year would maintain sufficient cover and food sources throughout the rotation. Protection of dune areas would insure some shinnery oak being present even after 5 years. Control of shinnery oak on large blocks of land is more economical than strip spraying and the relatively high mobility of lesser prairie chickens (Taylor and Guthery 1980a) allows them to fulfill cover requirements if treated blocks are 150 to 300 ha. Also, treating different blocks in different years could be incorporated easily into ranch management plans.

Tebuthiuron appears to be a promising tool for manipulation of lesser prairie chicken habitat on shinnery oak range. For lesser prairie chickens to survive, large tracts of native range must stay intact (Taylor and Guthery 1980b). Cattle operations must be economically successful to insure the maintenance of large tracts of native range. It is imperative that cattle operations also maintain vigorous stands of grass after application of tebuthiuron. Otherwise range condition may decline, wind erosion problems may increase, and lesser prairie chicken habitat will be poorer than before treatment. Therefore, we need to determine what grazing practices will maintain quality habitat for lesser prairie chickens (good range condition) and ensure good economic returns for landowners before final management recommendations can be made.

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